

COOPERATIVE COLONY FOUNDATION BY FEMALES OF THE LEAFCUTTING ANT *ATTA TEXANA* IN THE LABORATORY

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Abstract.—We describe a simple procedure for rearing colonies of the Texas leafcutting ant, *Atta texana* (Buckley), from foundress females in the laboratory. The progress and outcome of cooperative colony foundation attempts by several females is described. The results show that cooperative colony foundation (pleometrosis) in *A. texana* can lead to large polygynous colonies.

The leafcutting ants of the genus *Atta* have a major impact on natural and agricultural plant communities in the New World tropics and warm temperate zone. Available data suggest that most *Atta* species have monogynous colonies, but polygyny is commonly encountered in the Texas leafcutting ant, *Atta texana* (Buckley) (Moser, 1981). Colony founding females may aggregate and cooperate in excavating a common burrow after the mating flight. Multiple inseminated dealate females have been removed from established colonies in the field (Moser, 1967; Echols, 1966). Echols showed that young colonies could be joined together without aggression to produce artificially polygynous colonies in the laboratory.

Although colony foundation by some *Atta* species in the laboratory has been described (Huber, 1905; Autuori, 1956; Weber, 1972), the outcome of colony foundation attempts by cooperating females (pleometrosis) has not been previously examined in *A. texana*. Cooperative colony foundation in ants very rarely leads directly to mature polygynous colonies (Hölldobler and Wilson, 1977). Usually, extra foundress females are eliminated early in the colony life cycle, often before the first workers eclose. Most mature polygynous ant colonies apparently originate through the secondary adoption of additional inseminated females. Although Moser (1981) asserts that "*Atta texana* is the only known occurrence of pleometrosis leading smoothly to polygyny in ants," he does not provide any colony life histories to support the claim. This report describes simple techniques for the establishment of *A. texana* colonies in the laboratory, which were used to follow the progress of cooperating foundress females.

MATERIALS AND METHODS

Dealate females of *A. texana* were collected as they excavated burrows after mating flights in May 1983 and 1984. The flights occur before dawn on days after rainfall. Females were collected between 1000 and 1200 hours local time at three sites. In 1983, 13 females were collected at a greenhouse on the Texas A&M University campus and along a highway 22 km south of the campus. In 1984, 30 females were

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collected at Washington-on-the-Brazos State Park. The latter two sites were less than 100 m away from mature *A. texana* colonies, but the first site was probably at least 1 km from the nearest colony. None of the collection sites were near artificial lights, which attract alates (Moser, 1967). At each site, dealate females were concentrated in relatively small areas on barren or scattered grass and weed covered soil, and some females were found together, excavating a common burrow. One such group of five dealate females (Fig. 1) was kept together after collection in 1984. The others were reassembled in groups of two or three females for study of colony foundation in the laboratory.

The ants were placed in 10 × 7 cm high clear plastic dishes, lined along the bottom with perlite granules premoistened with distilled water. The closed dishes were kept in an incubator at approx. 27°C and 65% RH with a 16 hr day/8 hr night photoperiod, and were not reopened until worker eclosure was imminent. However, dying females were removed promptly and the spermatheca was examined upon dissection. In 1984, ten females were individually weighed and marked and grouped into five pairs.

When workers were expected, the dish lid was removed and fitted with a vertical plastic tube, initially plugged with a cork. The dish and tube were placed in or connected to a larger plastic foraging arena. Young colonies were maintained on a diet of cornmeal and oatmeal.

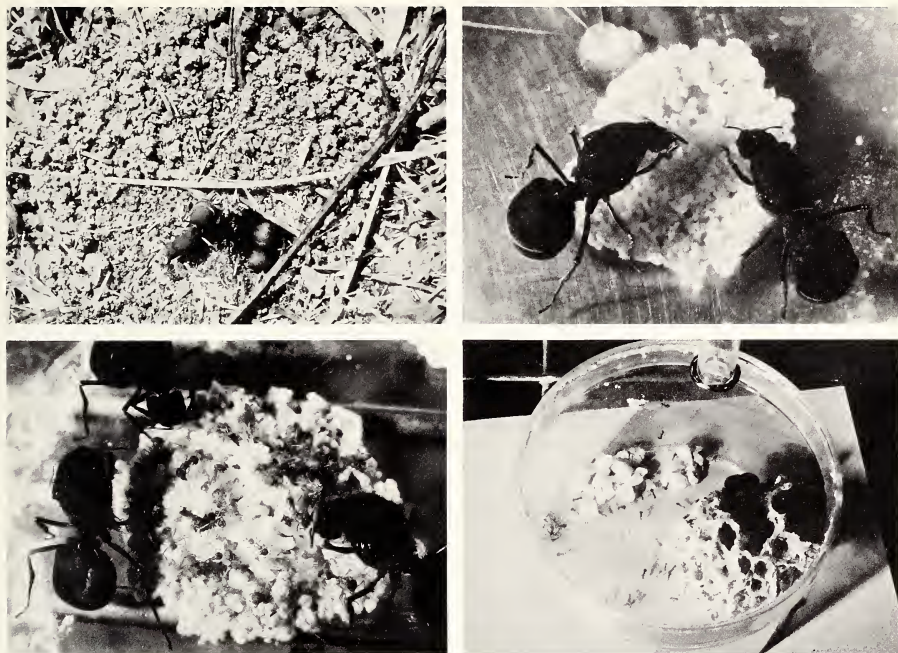
RESULTS AND OBSERVATIONS

The females regurgitated infrabuccal pellets within 24 hr after placement in the dishes and began oviposition after 24–48 hr. The females removed the perlite from an area in the center or on one side of the dish and kept their brood and fungus on the plastic surface in this cleared zone. They cultured the fungus and droplets of fecal fluid, as described for many other attine ants (Autuori, 1956; Wheeler, 1907; Weber, 1972). The fungal mat grew into a disk 20–30 mm across within four weeks (Fig. 2) and then remained about the same size until workers added new substrate later on.

Each female contributed eggs during pleometrotic colony foundation. The egg stage lasted 14–16 days. The females fed larvae with freshly laid eggs. Again, each female participated in larval feeding. Pupae appeared in the first brood eight to 10 days after the eggs hatched, and required 14 more days to complete development. In 1983, two groups of females required 40 days to rear workers in the laboratory. Each of five groups of females required 36 days to rear workers in 1984. Moser (1967) concluded that females of *A. texana* require 40–50 days to rear workers to maturity in the field in Louisiana. Not all groups survived to rear workers; two of four groups set up in 1983 lost their fungus to bacterial contamination and died with larval brood.

Females were placed together without any difficulty. In one case, dealate females collected at different sites were paired and successfully started a colony (Figs. 2, 4). Oral trophallaxis between females was not common, and allogrooming was not observed except when females were initially grouped. As a possible consequence, some females developed growths of opportunistic filamentous fungi on the dorsal surfaces of the gaster and thorax. The fungal growths did not seem to harm the females, but they were quickly removed by the first workers.

After flight, the mean weight of dealate females was 387 mg (N = 10; range: 349–423 mg). One of five pairs of weighed females failed to rear workers, but both females



Figs. 1–4. 1 (upper left). Cooperative burrow excavation by five *A. texana* females. The gasters of two digging females are visible, while a third female carries a soil pellet away from the entrance. 2 (upper right). A pair of females with their fungus after three weeks. Eggs and larvae are visible in the center of the fungal mat. 3 (lower left). Successful colony foundation by three cooperating females. Fungus, brood, and young workers are visible. One worker is grooming the gaster of the female at left. This colony died nine months later; spermathecal examination showed that all females had mated. 4 (lower right). Successful colony foundation by two females in Fig. 2. Two months after the first worker eclosed, the ants have removed all but the largest perlite granules through the exit tube at top center.

were inseminated. An inseminated female in a second pair died after 13 days. She had lost 22 mg and was replaced with another weighed ant. The replacement female had lost 122 mg when the first workers eclosed. The other seven females had lost 71–143 mg (mean 118 mg) when the first workers appeared, or about 30% of initial body weight (range: 20–36%).

Most first brood workers were three to four mm long, as Moser (1967) found in field samples, although a few smaller workers were also present. The first workers began to groom other individuals and tend brood within three days (Fig. 3). They also began exploring the dish interior and were walking on the sides and inner lid surface within five to seven days. Six to eight days after eclosure, the workers discovered the exit tubes and foraging began when the cork was removed. Ten days after the first worker eclosed, each pair of females had approximately 45–55 workers, while the group of five females had about 36 workers. Eight to 10 days after eclosure, the workers began to shape the material on the outer margin of the fungal disk into

ridges, producing a miniature 'amphitheater' with brood piled in the center as new substrate was added to the ridges. The workers removed the perlite from the culture dish and dumped it within two months as the fungus grew to about 50 ml (Fig. 4). One pair produced their first major worker in October 1983, five months after the females were collected.

DISCUSSION

Although this report and previous studies by Moser (1967, 1981) and Echols (1966) show that pleometrotic colony foundation attempts are common in *A. texana* and can lead directly to large polygynous colonies, the advantages of cooperative colony foundation remain less obvious. High genetic relatedness between females is not a prerequisite for pleometrotic colony foundation. Waloff (1957) suggested that co-operating ant females benefit from mutual grooming to remove pathogenic micro-organisms. Such behavior would seem particularly advantageous to ants like *A. texana* which must also maintain an uncontaminated fungus culture. Our failure to observe allogrooming is surprising, since the females carefully lick the plastic surfaces near the brood and fungus, and continue their routine self-grooming behavior.

Mated females which lack viable infrabuccal fungus pellets will obviously benefit by joining groups with viable fungus. Weber (1972) found that colony founding females of some *Atta* species commonly lacked fungal pellets after the mating flight. However, a careful count of regurgitated pellets showed that nearly all of our *A. texana* females contributed pellets after installation in culture dishes. Nevertheless, different pellets might still vary greatly in viability.

Cooperation during digging may allow females to complete and seal the natal burrow more quickly. Females which remain on the surface were quickly located and attacked by *Solenopsis invicta* (Buren). Although high *Solenopsis* population levels are only a recent problem, other opportunistic ant predators such as *Pheidole* spp. and *Iridomyrmex pruinosum* may have been a long term threat to *A. texana* females on the ground. In western Mexico, colony founding females of *A. mexicana* (F. Smith) were attacked by *Pheidole* spp., *Iridomyrmex pruinosum* (Roger), and the native *Solenopsis xyloni* McCook (Mintzer, pers. obs.). However, *A. mexicana* females did not excavate cooperative burrows and were aggressive when placed together. A comparative field study of colony foundation in the two *Atta* species might illuminate the factor(s) responsible for pleometrosis and polygyny in *A. texana*.

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